SHORE POWER CONNECTION BOX

1. **SCOPE**. This specification covers the requirements for a portable shore power connection box with integral bus bars for use in splicing lugged 500 kcmil and 800 kcmil cables. Connection box is for use in the industrial and maritime environment of a Naval shipyard. Unit shall be rated 480 volt, 3 phase, 3 wire, 4000 amps and be listed and labeled by an accredited electrical testing laboratory. Unit must be constructed to withstand 135,000 amps short circuit current.

2. **APPLICABLE REFERENCES**. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids shall apply.

ASTM B 187-B 187M-03 - Standard Specification for Copper Bar, Bus Bar, Rod and Shapes

UL 50	- Enclosures for Electrical Equipment
UL 746B	- Polymeric Materials - Long Term Property Evaluations
UL 746C	- Polymeric Materials - Use in Electrical Equipment Evaluations
UL 891	- Dead Front Switchboards
MIL-C-5541	- Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625	- Anodic Coatings for Aluminum and Aluminum Alloys

3. **REQUIREMENTS.** Requirements in this specification are designed to assure procurement of equipment that (1) provides a means to readily splice large lugged portable power cables; (2) has bus, bus supports, and bus bracing of specified ampacity and short circuit current rating; (3) is portable and ruggedly built and weatherproof; and (4) has dimensions not exceeding space available at user's site.

3.1 DESCRIPTION. See Figures 1 & 2 for conceptual views showing cable entrance requirements, dimensions, and bus drilling. The shore power connection box shall be rated 480 volt, 3 phase, 3 wire, 4000 amps and be listed and labeled by an accredited electrical testing laboratory of Paragraph 4.2 (a) below. Unit must be constructed to withstand 135,000 amps short circuit current. Unit shall have weatherproof-hinged covers to facilitate cable connection and shall be constructed so as to exclude entrance of rainwater above live parts. Unit shall be designed to connect up to ten lugged single-conductor 800 kcmil portable power cables per phase and per side. Unit shall be freestanding and shall have a rugged base and shall be designed to allow handling by forklift and crane. Design and construction shall provide the strength and rigidity needed for the unit to keep its shape and for hinged covers to close tightly. Unit is intended for use outdoors in a salt-laden marine atmosphere and under conditions of varying temperature and heavy vibration during movement. Operating temperature of the bus work shall not exceed 90 deg C when operating in 40 deg C ambient temperature. Space availability at the shipyard is limited and overall dimensions must therefore be minimized; all cable entering each side of the box must enter through a single access opening on each side of the box.

ATTACHMENT 1

3.1.1 NEW DEVELOPMENT. If, during the contraction period, any new developments are generated that would improve the efficiency, accuracy or productivity of the equipment and its related equipment or decrease its operation cots, the contractor shall notify the Contracting Officer. Reports of such developments shall be addressed to the Contracting Officer

3.1.2 SAFETY AND HEATH REQUIREMENTS. Covers, guards, or other safety devices shall be provided for all parts of equipment that present safety hazards. Safety devices shall not interfere with operation of the equipment. The devices shall prevent unintentional contact with the guarded part and shall be removable to facilitate inspection, maintenance and repair of the parts. Machine parts, components, mechanisms, and assemblies furnished on the unit shall comply with all specific requirements of "OSHA Safety and Health Standards (29 CFR 1910), General Industry" that are applicable to the equipment itself. Additional safety and health requirements shall be as specified in other paragraphs of this specification. The design and manufacture shall be in accordance with all applicable OSHA safety standards.

3.1.3 OSHA APPROVED CERTIFICATION. The equipment installation and its component parts shall be in compliance with the applicable OSHA regulations in accordance with CFR Title 29, Chapter XVII, Part 1910 and installed in accordance with NEC/NFPA requirements. Approval shall be as specified under the "Approval" and "Acceptance" criteria in the OSHA regulations Subpart "O", Machinery and Machine Guarding paragraph 1910.212 and Subpart "S" Electrical, paragraph 1910.303 and paragraph 1910.399. After equipment delivery, and prior to testing, the contractor shall provide an OSHA Certification Report. Failure to provide this certification report will delay acceptance of the equipment, and could result in rejection for failure to comply with the terms of the contract. This report documents the results of all tests performed, provides an assessment of the equipment performance for compliance with the contract requirements, and forms a basis for recommending a safety certification. The report, test and evaluation shall be a composite of those inspection requirements specified in the contract. The report shall be prepared in an orderly manner to clearly and accurately set forth the collected data and conclusion resulting from these inspection requirements, opinions and subjective conclusions shall be clearly identified. The report shall include, but is not limited to, the following:

a. List of all tests performed and by whom witnessed.
b. List of data used for evaluation.
c. Tabulation of all discrepancies related to specification performance requirements.
d. Description of limitations revealed by data utilized.
e. Actions taken to mitigate each discrepancy and limitation.
f. Recommendations for subsequent actions.
g. Summary conclusions.
h. Manufacturer Certification that equipment has been manufactured and installed to OSHA CFR 1910.399 (per definition of "acceptable").

3.2 MATERIALS

3.2.1 FERROUS PARTS. All exposed ferrous parts such as screws, bolts, nuts, washers, etc., shall be chrome plated, galvanized or otherwise surface protected by an electrical/chemical process or of stainless steel to resist corrosion in a salt-laden moist, variable temperature environment.

3.2.2 ALUMINUM PARTS. All aluminum parts for use outdoors shall be anodized in accordance with MIL-I-8625 or chemically treated in accordance with MIL-C-5541, followed by two coats of weather-resistant exterior paint.

3.2.3 DISSIMILAR METALS. Intimate contact between dissimilar metals which can be expected to cause galvanic corrosion shall be avoided as much as practicable. When such contact cannot be avoided, an interposing insulating material shall be provided to minimize the corrosion effect.

3.2.4 ASBESTOS RESTRICTION. The use of asbestos and materials containing asbestos on or in the furnished equipment is prohibited.

3.2.5 POLYCHLORINATED BIPHENYL (PCB) RESTRICTION. The use of polychlorinated biphenyl on or in the equipment is prohibited.

3.2.7 CADMIUM RESTRICTION. The use of cadmium and materials containing cadmium on or in the furnished equipment is prohibited.

3.2.8 LITHIUM RESTRICTION. The use of lithium and materials containing lithium on or in the furnished equipment is prohibited.

3.2.9 METHYLENE CHLORIDE RESTRICTION. The use of methylene chloride and materials containing methylene chloride on or in the furnished equipment is prohibited.

3.2.10 LEAD RESTRICTION. The use of lead and materials containing lead on or in the furnished equipment is prohibited.

3.3 WORKMANSHIP.

3.3.1 STEEL FABRICATION. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions that would be deleterious to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. All bends shall be made by controlled means to ensure uniformity of size and shape.

3.3.2 BOLTED CONNECTIONS. Boltholes shall be accurately punched or drilled and shall have the burrs removed. Washers or lock washers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.3.3 RIVETED CONNECTIONS. Rivets may be used for minor attachments (e.g., label plates). Rivets shall not be used for main structural support. Rivet holes shall be accurately punched or drilled and shall have the burrs removed. Rivets shall be driven with pressure tools and shall completely fill the holes. Rivet heads, when not countersunk or flattened, shall be of an approved shape and of uniform size for the same diameter of rivet. Rivet heads shall be full, neatly made, concentric with the rivet holes, and in full contact with the surface of the member.

3.3.4 WELDING. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of

the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.4 ELECTRICAL DESIGN

3.4.1 GENERAL. Construction shall be per Table 24.1 and Supplement "B" to UL 891 except as otherwise shown for the configuration in Figure 1 and except as otherwise specified herein. Bus supports may be suitable non-conductive structural sections instead of the standoff type. Supports must meet the performance tests of section SB4 of UL 891. Bus bars and supports shall be designed and supported to withstand a short circuit current of 135,000 amperes RMS symmetrical. Bus and bus supports must also withstand the loads that would be produced by the weight of the installed cable and force of pulling on the cables at installation. Supports shall be designed to minimize dirt collection and to facilitate cleaning. Bus bars, bus supports and associated supporting structural members shall be designed by a registered professional engineer.

3.4.2 INSULATION. Insulation material shall provide the level of performance specified for direct and indirect support of live parts in UL 746C. Relative thermal index of insulation per UL 746B shall be at least 130 deg C electrical and 130 deg C mechanical. A front safety barrier of insulating material shall be provided over ends of bus work otherwise exposed when the front doors are open.

3.4.3 BUS BARS. Bus bars shall be copper per ASTM B 187-B 187M-03. One bus shall be provided for each phase of the 480-volt, 3 phase, 3-wire system. Bus bars shall be suitable for continuous operation at 4000 amps. Operating temperature of the bus bars shall not exceed 90 deg C in a 40 deg C ambient. Adequate spacing shall be present to allow for lugs to be placed onto both sides of each bus bar/phase (i.e., back-to-back) and still meet 480 VAC clearance requirements between all three phases. See Figure 2 for bus bar hole size/configuration requirements. Bus shall be drilled to permit connection of ten (10) 900 kcmil, 2-hole lugs along each side of the bottom edge of each bar. The bending of bars shall not result in visible cracks, but roughening or slight surface crazing is acceptable. Bus bars shall be provided with a full set of hardware (Grade 8 or better steel hexagonal head bolts, flat washers and nuts) suitable for installing ten (10) 900 kcmil, 2-hole lugs to each bus bar.

3.4.4 GROUNDING. All exposed, non-current-carrying metal parts on the equipment shall be maintained at common, zero ground potential. Enclosure shall be provided with a steel grounding pad welded on or near the base of the enclosure. Pad shall be sized and installed for connection of a lugged 500 kcmil grounding cable. Pad shall be drilled for two 1/2-inch diameter bolts on 1-3/4 inch centers. All main doors shall have grounding straps across the hinged components such that the hinge is not relied upon for the grounding path.

3.4.5 AUXILIARY. No auxiliary electrical equipment (transformers, heaters etc.) that connects electrically to the main bus bars shall be provided.

3.4.5 BUS BAR SUPPORTS. Bus bar supports system, including any I-beams, shall be expected to withstand operating temperatures of 90 deg C in a 40 deg C ambient environment.

3.5 ENCLOSURE.

3.5.1 ENCLOSURE DESIGN. The enclosure will be designed for outdoor use. No water shall enter the enclosure above live parts when subjected to the rain test of UL 50; temporary closures may be installed over the cable access openings during the test. The enclosure shall

be designed so that any water that enters will drain from the enclosure. Drain holes shall be present at each of the four corners in the base. The enclosure shall meet the requirements of UL 50 for protection against corrosion.

Enclosure shall be constructed of heavy gauge steel and shall be sufficiently rugged to allow movement by crane and by forklift traveling over uneven pavement and train tracks. Enclosure, including bus bars, shall be constructed to withstand the loads that would be produced by the weight of the installed cable and force of pulling on the cables at installation as well as forces developed by 135,000 amps short circuit current. Enclosure shall meet the minimum thickness requirement of UL 50.

Enclosure shall be sized to fully enclose all bus bars and shore power cable lugs, and shall be sized and arranged to facilitate access for installation, and bolting-up, of the lugged shore power cables. Enclosure front shall have weatherproof-hinged cover; cover shall be of positive rain-excluding design and construction and shall open the full height of the enclosure (less any necessary framing). Covers shall be hinged on the side and shall have padlocking capability.

A cable access opening shall be provided on each side as shown in Figure 1. To protect cables from damage, all edges of cable access openings shall have a minimum radius of 1/4-inch. A door or cover, hinged at the top, shall be provided over the access as shown in Figure 1. The door or cover shall effectively close the access when cables are not installed and shall have provisions for padlocking shut and for holding in an open position. The bottom edge of the cable door cover that contacts temporary cabling (when installed) shall be designed in such a manner to ensure the integrity of the temporary cables is not subjected to damage from the door edge.

All enclosure doors shall be electrically bonded to the enclosure via the use of suitably sized grounding means. Door hinges will not be considered an acceptable means of bonding.

All parts, components, mechanisms, and assemblies furnished on the unit shall comply with all specific requirements of "OSHA Safety and Health Standard (29 CFR 1910), General Industry" that are applicable to the equipment itself.

3.5.2 LIFTING PROVISIONS.

3.5.2.1 Enclosure base shall include forklift tine guides with inside dimensions of approximately four inches high by eight inches wide. The guides shall be placed approximately 36 inches apart, center-to-center on the front/rear (48-inch side) and approximately 20 inches apart, center-to-center on the sides (32-inch side). Base shall be designed so that there is forklift access from all four sides. All sides of base shall protrude beyond the enclosure by approximately 3 inches to aid in protecting the enclosure during transit by forklift.
3.5.2.2 Enclosure shall have certified crane lifting padeyes following the requirements below:

3.5.2.2.1 For design purposes, only 2 diagonally opposed lift points shall be considered to support the weight of the equipment, regardless of the total number of lift points used.

3.5.2.2.2 Vertical Design Load shall be taken as the base equipment weight plus 10%. The base equipment weight is what the assembled item weighs, as delivered, plus the maximum possible weight of all fluids or materials that the item is capable of containing when used as designed. The 10% is to account for any future modifications, changes, or additions to the equipment which would increase the weight.

3.5.2.2.3 Working Load Limit (WLL) shall be calculated by multiplying the portion of the Vertical Design Load applied to each of the two diagonally opposed lift points by a factor of 1.155 (to account for a minimum rigging gear sling angle of 60° above horizontal). The WLL shall be used for all lift point design calculations and while based on only two lift points supporting the load, applied to each lift point installed.

3.5.2.2.4 The lift points, and the equipment structure to which the lift points are attached, shall be checked by a qualified engineer for adequacy per the requirements presented here. Analysis of the equipment structure shall also include buckling analysis per AISC, Allowable Stress Design methodology, as needed, to verify integrity of the structure, considering the loadings imposed by the orientation of the WLL as described herein. Calculations supporting the lift point design shall be submitted for review prior to acceptance of the equipment. Allowable stresses for the lift points shall be based on the following:

YS = Yield Strength (minimum)
UTS = Ultimate Tensile Strength (minimum)

$$F_{ALL} = MINIMUM\left[\frac{YS}{3} OR \frac{UTS}{5}\right]$$ (Allowable bending/tensile stress. Use the minimum value.)

$$\tau_{ALL} = \frac{F_{ALL}}{\sqrt{3}}$$ (Allowable shear stress)

$$\sigma_{BEARING} = 1.5 * \frac{UTS}{5}$$ (Allowable bearing stress. Based on projected area of shackle pin.)

3.5.2.2.5 Orientation of lift points shall be such that when loaded, the direction of lifting load will be in the plane of the padeye plate ± 5°. Location of lift points shall be symmetrical with respect to the equipment center of gravity (CG). Lift points shall also be in a common horizontal plane above the CG. Location of lift points shall consider that each leg of lifting gear will be of equal length. The equipment shall lift level within 3°. If the equipment is intended to be stackable, provisions in the design shall be made to prevent damage to the lift points of the lower item if the upper item is not landed accurately or symmetrically. When lift points are installed on the supporting structure by welds that carry the lifted load, welding shall be performed and visually inspected in accordance with AWS D1.1.

3.5.2.2.6 Each lift point shall be load tested to 200% of WLL and held under load for 2 minutes. Acceptance criteria shall be: no bending, cracking, or permanent deformation of the lift points or associated supporting structure. Documentation shall be provided on the fabricator's company letterhead stating that each lifting pad has successfully passed the 200% test. The fabricator shall mark the lift points in a permanent manner with the WLL, test date, and test load applied. All weights shall be marked in pounds.

3.5.3 LABELING. Labels shall be of a type and installed in a manner so as to be permanent under ordinary usage including exposure to weather and handling. Except as otherwise specified, labels may be inside or outside the enclosure. Labels shall be permanent, corrosion-resistant material.

3.5.3.1 IDENTIFICATION PLATE. A nameplate of corrosion-resistant metal shall be installed on the front of the unit with nonferrous metal screws, rivets, or bolts of not less than 1/8-inch diameter. The nameplate shall be permanently and legibly marked by inscribing or stamping manufacturer's name, model and serial number, ampacity, voltage, phases, short circuit withstand rating in RMS symmetrical amperes, weight, date of manufacture, and

contract number.

3.5.4 CLEANING. TREATMENT AND PAINTING. The entire enclosure shall be painted. Surfaces to be painted shall be cleaned and dried to insure that they are free from scale, water, dirt, corrosion product, or any other contaminating substances. As soon as practicable after cleaning, and before any corrosion product or other contamination can result, the surfaces shall be prepared or treated to insure the adhesion of the coating system. The painting shall consist of at least one coat of primer and at least two finish coats of weather resistant exterior paint. The primer shall be applied to a clean, dry surface as soon as practicable after cleaning and treating. Painting shall be with manufacturer's current materials according to manufacturer's current processes and the total dry film thickness shall be not less than 2.5 mils over the entire surface. The final painted appearance shall be smooth and free from defects. Only lead-free and chromate-free materials shall be used.

3.5.5 HINGES. All hinges used in the construction of the enclosure shall be stainless steel, two piece split barrel, fixed pin, "bullet" type hinges. Hinges shall be attached to the enclosure by welding. A minimum of two (2) hinges shall be provided on each hinged access door or panel.

4. QUALITY ASSURANCE PROVISIONS.

4.1 DRAWINGS AND CALCULATIONS FOR DESIGN REVIEW. Include required information per Contract Data Requirements List (CDRL) Product Drawings/Models and Associated Lists DI-SESS-81000E. Drawings must show bus cross-section, and bus supports and attachment. Calculations must verify bus ampacity and short circuit withstand rating are as specified. Drawings should also show structural details including sheet steel gages, structural members, welding and fasteners, forklift tine guides, lifting padeyes, access openings for cables, space available for bolting lugs to buses, and enclosure drainage.

4.2 REQUIREMENTS REGARDING OSHA APPROVAL. Include required information per (CDRL) Certification/Data Report DI-MISC-80678 (DD).The equipment specified herein shall be in compliance with the applicable OSHA regulations and approved in accordance with CFR Title 29, Chapter XVII, Subpart "S", Part 1910.399 (i) [paragraph (a) below] or Part 1910.399 (iii) [paragraph (b) below]. Unit(s) will not be approved per Part 1910.399 (ii).

a. Approval as specified under Part 1910.399 (i) requires the equipment to be accepted, certified, listed, labeled, or otherwise determined to be safe by a nationally recognized testing laboratory. Accredited Electrical Testing Laboratories approved by OSHA are as follows:

American Gas Association Laboratories (AGA)
(216) 524-4990 Cleveland, Ohio

Canadian Standards Association (CSA)
(416) 747-4000 Ontario, Canada

Communication Certification Laboratory (CCL)
(801) 972-6146 Salt Lake City, Utah

Dash, Straus, and Goodhue, Inc. (DSG)
(508) 263-2662 Foxborough, Massachusetts

ETL Testing Laboratories, Inc. (ETL)
(800) 345-3851 Cortland, New York

Factory Mutual Research Corporation (FMRC)
(617) 762 -4300 Norwood, Massachusetts

MET Laboratories, Inc. (MET)
(800) 638-6057 Baltimore, Maryland

Southwest Research Institute (SWRI)
(512) 684-5111 San Antonio, Texas

Underwriters Laboratories, Inc. (UL)
(708) 272-8800 Northbrook, Illinois

United States Testing Company, Inc. (UST-CA)
(213) 723-7181 Los Angeles, California

Or

b. Approval as specified under Part 1910.399 (iii) requires that for custom-made equipment (which is not listed), the manufacturer shall determine that it is safe for intended use on the basis of test data that shall be submitted with the equipment for the end user's records. Test data shall include records certifying that the unit satisfactorily passed a three consecutive hour (minimum) full load (4000 ampere) 480 Volt, 3 phase test.

5. **DATA REQUIREMENTS.** The following minimum information shall be provided with the connection box:

a. Two copies of the Assembly and Detail drawings showing dimensions and tolerances and torque values. Also see 4.1 above.
b. Two copies of the complete parts list showing the manufacturer, model, and/or part number, and material specification of each part.
c. Two copies of the Test data required by 4.2 (b) above (if applicable).
d. One compact disk with all information associated with a, b, & c above in PDF format.

FIGURE 1, 4000 AMP
JUNCTION BOX

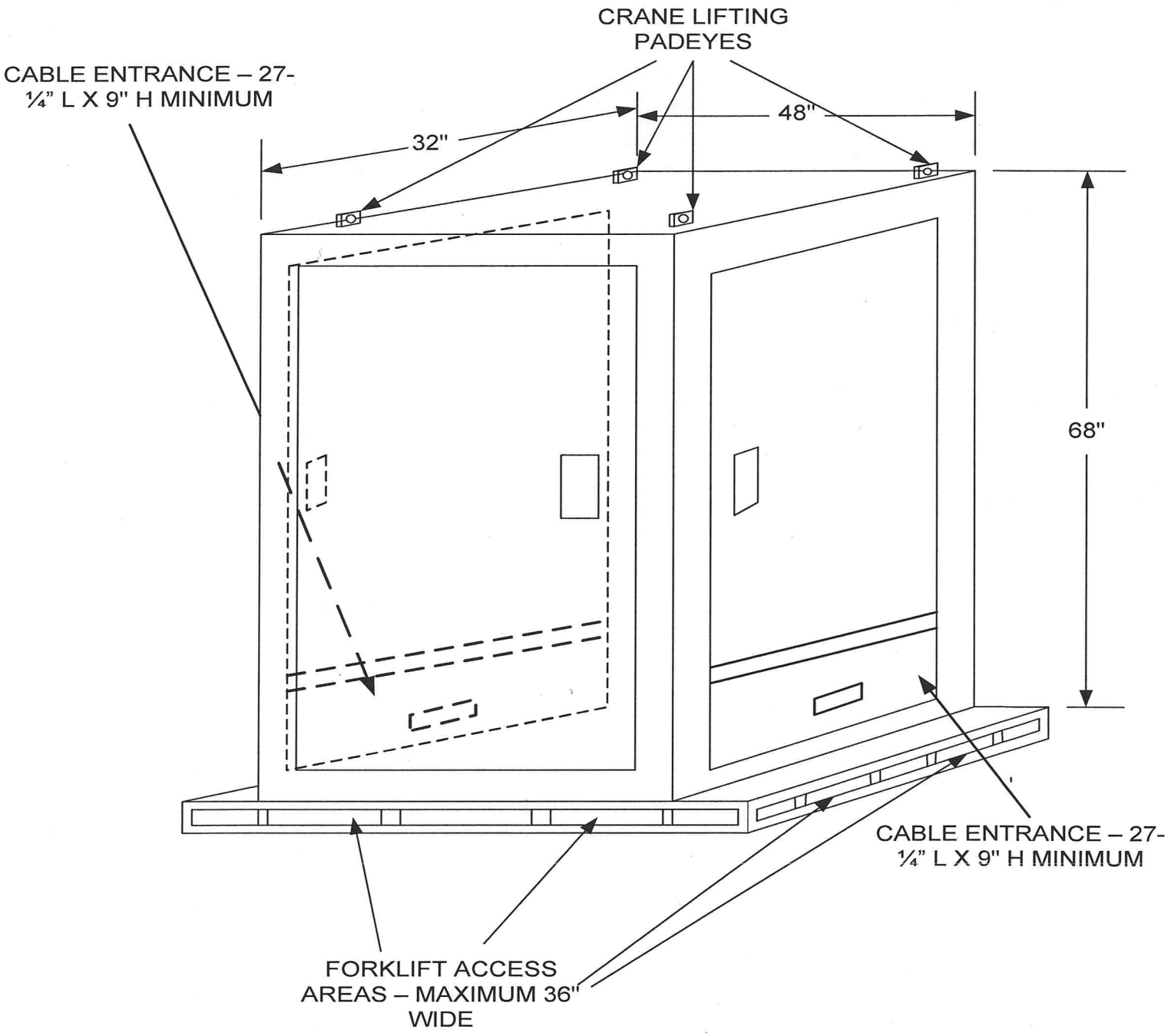
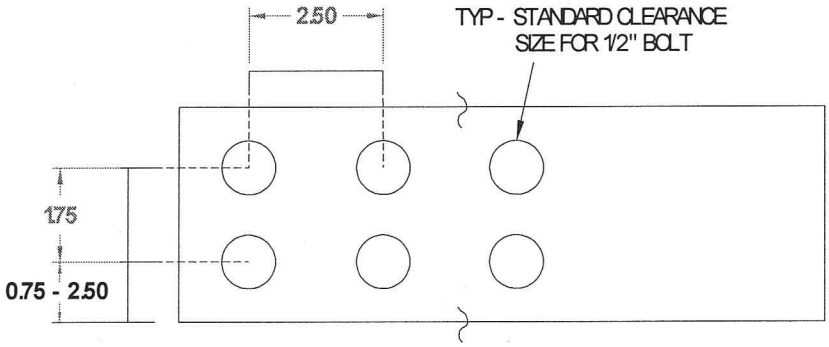
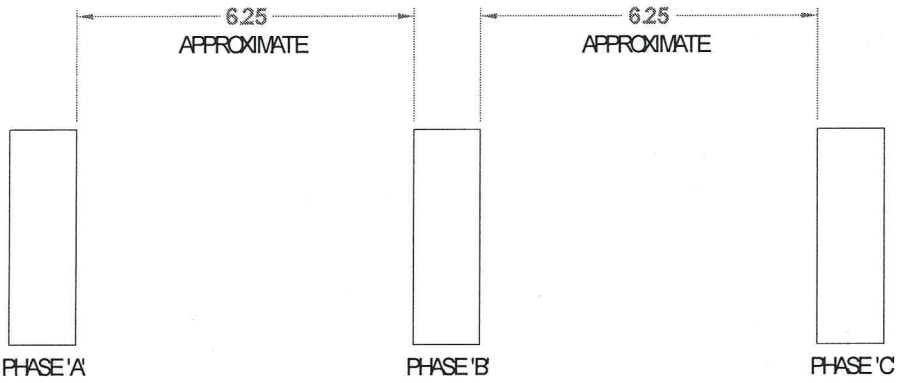


FIGURE 2
4000A - SHORE POWER CONNECTION BOX



FRONT VIEW OF TYPICAL BUS BAR



SIDE OR CUTAWAY VIEW OF COPPER BUS BARS

ADEQUATE SPACING SHALL BE PRESENT BETWEEN PHASES TO ALLOW FOR 500/900 KCMIL LUGS TO BE PLACED ONTO BOTH SIDES OF EACH BUS BAR/PHASE (BACK-TO-BACK) AND STILL MEET THE 480 VAC CLEARANCE REQUIREMENTS BETWEEN ALL THREE PHASES.